R V R & J C COLLEGE OF ENGINEERING (Autonomous), CHOWDAVARAM, GUNTUR-19
B.Tech. Computer Science & Engineering (IoT) **(R-20)**

Semester -VII (Fourth Year)

S.No	Course Code	Course Title	Hours Per Week		Scheme of Examination			Category
			L	P	Internal Marks	Sem End Exam Marks	Credits	
1	CO 411	Humanities & Social Sciences Elective	3	0	30	70	3	HS
2	CO 412	Professional Elective – III	3	0	30	70	3	PE
3	CO 413	Professional Elective – IV	3	0	30	70	3	PE
4	CO 414	Professional Elective – V (MOOCS)	0	0	-	100	3	PE
5	CO 415	Open/Job-Oriented Elective – III	3	0	30	70	3	OE
6	CO 416	Open Elective – IV (MOOCS)	0	0	-	100	3	OE
7	CO 451	Industrial Internship / Professional Certification	-	-	100	-	3	PR
8	COSL5	Skill Oriented Course – V	1	2	100	-	2	SC
		TOTAL	**13**	**2**	**320**	**480**	**23**	

Category	CREDITS
Professional Elective Courses	9
Open Elective Course/Job Oriented Elective	6
Humanities And Social Science Elective	3
Skill Advanced Course	2
Industrial/Research Internship	3
TOTAL CREDITS	**23**

CO 411	Humanities & Social Sciences Elective- Subjects	
S.NO	**Subject Code**	**Name of the Subject**
1.	HSEL1	Industrial Management & Entrepreneurship
2.	HSEL2	Economics for Engineers
3.	HSEL3	Introduction to Industrial Management
3.	HSEL4	Project Management & Entrepreneurship

CO 411

HSEL1- INDUSTRIAL MANAGEMENT & ENTREPRENEURSHIP

L	P	C
3	0	3

Course Objectives:

1. To enable the student to demonstrate a thorough working knowledge of Management and Organizations.
2. To alert the students in regular business activity on Time values of money and depreciation.
3. To motivate the students on Entrepreneurial Perspectives at present business.
4. To enable the student on the MSME sector and motivate the startup of MSME and support agencies.

Course Outcomes:

After successful completion of the course, the students are able to

1. To gain insight into contemporary issues in Management and Business Organization
2. Ability to identify, analyze and interpret various concepts of time values of money and depreciation.
3. An understanding of the impact of knowledge on Entrepreneurship to enable the student to meet the needs of Industry
4. Recognition of the needs and ability to MEME and Support Agencies

UNIT I **CO1** **15 Periods**

Management and Business Organization: Management Concept-Managerial and operational functions of management-Scientific management-Job Design-Job description and job specification. Sole Proprietorship, Partnership Firm, Limited Liability Partnership (LLP), Joint Stock Company, One Person Company (OPC), Private Company; Public Limited Company, Forms of Organization, Co- Operatives.

UNIT II **CO2** **15 Periods**

Time values of money and depreciation: Simple interest -Compound Interest-Present worth factors Future worth factors-Depreciation Concept-Straight-line method of depreciation-Diminishing method of depreciation-Sum of the year digits method of depreciation etc. along with problems

UNIT III **CO3** **15 Periods**

Entrepreneur and Entrepreneurship: Concept of Entrepreneur-Characteristics of an Entrepreneur Distinction between an Entrepreneur and Entrepreneur and a Manager – Functions of an Entrepreneur-– Types of entrepreneurs- Recent Trends of Women Entrepreneurship – Rural Entrepreneurship Entrepreneurial process – Growth of Entrepreneurship in India

UNIT IV **CO4** **15 Periods**

MSME and Support Agencies: Meaning of MSME-Definitions of MSME, Characteristics of MSME- – Relationships of MSME- Certificate of MSME –Make in India concept of MSME-Commercial Banks financial institutions – (KVIC) Khadi and Village Industries Commission-(SIDO) Small Industries Development Corporation –(NSIC) National Small Industries Corporation-(NPC) National productivity council- (DIC) District Industries Centre- (SFC) State Financial corporation.

Text Books:

1. KK Ahuja, Industrial Management, Vol. I & II, Dhanpat Rai, 1978.
2. E.Paul Degarmo, John R Chanda, William G Sullivan, Engineering Economy, Mac Millan Publishing Co, 1979. B.Tech.(HS)/R-18/2018-2019 Page 1/ 2.
3. Poornima M Charantimath, Entrepreneurship Development Small business environment, Pearson Education
4. Shivganesh Bhargav, Entrepreneurial Management, Sage Publications, 2008.
5. Prasanna Chandra, Project Management, Tata McGraw-Hill Education, 2013 Edition,

Reference Books:

1. Philip Kotler, Marketing Management, 11th Edition, Pearson Education, 2004.
2. P. Gopalakrishnan, Hand Book of Materials Management, PHI, 1999.
3. Gary Dessler, Human Resource Management, 11th Edition, 2008.
4. Heinz Weirich and Harold Koontz, Management, 10th Edition, TMH, 2004.

CO 411

HSEL02- ECONOMICS FOR ENGINEERS

L	P	C
3	0	3

Course Objectives:

1. To provide the students with knowledge of basic economic problems and the relationship between engineering technology and economics.
2. To make the students understand the demand determinants and the methods of demand forecasting of a product.
3. The students gain the knowledge about various cost concepts for determining the manufacturing of a product.
4. To sensitize the students about the changing environment of banking scenario andto understand the functions of RBI.

Course Outcomes:

After successful completion of the course, the students are able to

1. Understand the basic economic problems and objectives of a firm.
2. Get knowledge about overall functions and concepts of Demand elasticity of thefirm and forecasting.
3. Linkage of various cost concepts and to understand how to sustain break even for a business.
4. Know the overview of Liberalization, Privatization and Globalization and their impact on Indian economy.

UNIT I **CO1** **15 Periods**

ENGINEERING ECONOMICS: Economics definition - Functions & Scope of Engineering economics- Basic economic problem - Relationship between Science - Engineering - Technology - Economics.

FIRMS OBJECTIVE: Theories of Maximization - Profit Maximization - Wealth Maximization - Growth Maximization - Sales Revenue Maximization - Utility Maximization.

UNIT II **CO2** **15 Periods**

THEORY OF DEMAND: Demand Definition - Nature and Characteristics of Demand - Demand schedule Law of demand - Limitations to the law of demand - Various concepts of Demand Elasticity– Price Elasticity - Income Elasticity - Cross elasticity - Demand Forecasting definition - Factors determining Demand Forecasting - Methods of Demand forecasting.

UNIT III **CO3** **15 Periods**

COST CONCEPTS: Introduction - Types of costs - Fixed cost - Variable cost - Average cost – Marginal cost - Real cost - Opportunity cost - Accounting cost - Economic cost - Break - Even analysis.

UNIT IV **CO4** **15 Periods**

INDIAN ECONOMY - AN OVERVIEW: Nature and characteristics of Indian economy – Banking - Structure of Indian Banking- RBI functions - Functions of Commercial banks - Merits and Demerits of Liberalization - Privatization – Globalization (LPG) - Elementary concepts of WTO - GATT- GATS - TRIPs - TRIMs - Monetary Policy - Fiscal Policy.

Text Books:

1. Riggs, Bedworth and Randhwa, Engineering Economics, McGraw-Hill Education India.
2. S.C. Sharma and T.R. Banga, Industrial Organization and Engineering Economics, Khanna Publishers.
3. S.K.Misra and V.K.Puri, Economic Environment of Business, Himalaya Publishing House. H.L.Ahuja, Managerial Economics, S.Chand Publishing.

Reference Books:

1. Singh A and Sadh A.N., Industrial Economics, Himalaya Publishing House, Bombay
2. R.L.Varshney & K.L.Maheswari, Managerial Economics, S.Chand Publishing ,2003Edition
3. Datt & Sundharam, Indian Economy, S.Chand Publishing, 2014 Edition

Web Recourses:

1. www.managementstudyguide.com: Describes about the amalgamation of economic theory with business practices.
2. www.tutorialspoint.com: Provides a platform to learn various courses discussed inthe syllabus.

CO 411

HSEL3-INTRODUCTION TO INDUSTRIAL MANAGEMENT

L	P	C
3	0	3

Course Objectives:

1. To provide the students a foundation in concepts and skills in management.
2. To make the students understand the concept of interest and evaluation of project alternatives.
3. Prepare the students for facing the changing environment, its implication on human resources and to achieve the corporate excellence.
4. Provide awareness about the materials requirement and procurement, in order to produce good quality products and maintain quality as desired by the consumer.

Course Outcomes:

1. The course helps the students to become aware of the inference of organization structure and performance of people working in organizations.
2. The course helps students to get knowledge about time value of money, evaluation of alternatives in the changing economic environment.
3. The course helps the students to understand the elements of human resource management to acquire competitive advantage.
4. The course helps the students to use right sort of material for delivering the right products and services to the market.

UNIT I **CO1** **15 Periods**

GENERAL MANAGEMENT: Management Concept, Managerial levels, Managerial Skills, Managerial levels v/s skills, Brief treatment of managerial functions, Scientific Management Principles, Administrative Principles of Management.

FORMS OF BUSINESS ORGANISATION: Salient features of sole proprietorship. Partnership, Joint Stock Company, Private limited and Public limited companies.

UNIT II **CO2** **15 Periods**

FINANCIAL MANAGEMENT: Objectives of Financial Management – Concept of money - Simple interest – Compound interest Equivalent cash flow diagram.

ECONOMIC EVALUATION OF ALTERNATIVES: Basic methods – the annual equivalent method– Present worth method – future worth method.

DEPRECIATION: Purpose – Definition – types of depreciation – common methods of depreciation– The Straight-Line Method – Diminishing Balance Method - the sum of the Years Digits Method.

UNIT III **CO3** **15 Periods**

HUMAN RESOURCE MANAGEMENT: Functions of Human Resource Management – Job Analysis – Human Resources Planning – Brief treatment of Recruitment - Selection – Placement - induction & Orientation – Training and Development - Performance Appraisal.

UNIT IV **CO4** **15 Periods**

MATERIAL MANAGEMENT: Functions of Materials Management - Material Requirement Planning – Purchasing – Objectives of Purchasing – Sources of Selection – Procurement Methods – Vendor Rating – Inventory Management – EOQ – EPG – ABC Analysis.

MARKETING MANAGEMENT: Functions of Marketing – Marketing Mix – Product life cycle – channels of distribution – Marketing Segmentation – Advertising & Sales promotion – Market Research.

Text Books:

1. KK Ahuja, Industrial Management and Organizational Behavior, Khanna Publishers.
2. Pravin Kumar, Industrial Engineering and Management, Person Publications.
3. N.V.S. Raju, Industrial Engineering and Management, Cengage Learning.

Reference Books:

1. Philip Kotler, Marketing Management, 11th Edition, Pearson Education.
2. Gary Dessler, Human Resource Management, Pearson Education 11th Edition.
3. Heinz Weirich and Harold Koontz, Management, 10th Edition, TMH.

Web References:

1. www.managementstudyguide.com: Describes the Concepts of Management & Its Operational Functions.
2. www.1000 ventures.com: Describes about Management Gurus, Business Gurus.

www.citehr.com: Describes the Human Resource Management Topics.

CO 411

HSEL4 - PROJECT MANAGEMENT & ENTREPRENEURSHIP

L	P	C
3	0	3

Course Objectives:

1. To grasp the project identification, Planning and execution of the projects.
2. To understand the project analysis, apply appropriate project tools and techniques.
3. To develop Entrepreneurial creativity and Entrepreneurial initiative, adopting the key steps in the elaboration of business idea.
4. To be aware the growth and development of Entrepreneurial process and the resources needed for the successful development of Entrepreneurial ventures.

Course Outcomes:

After successful completion of the course, the students are able to

1. Understand the conceptual clarity about project identification, formulation and feasibility analysis.
2. Analyze the learning and implementation of the project techniques for project planning, scheduling and execution.
3. Utilize the ideas to create value.
4. Self-advocacy and problem-solving skills and manage strong identity purpose.

Course Content:

UNIT I **CO1** **15 Periods**

Project Identification and Formulation: Meaning and definition of Project - concepts - Project Life cycle - Project Identification - Project Selection - Source of Finance for a Project- Project appraisal (Theory) - Technical, Financial, Market appraisal - preparation of detailed project report.

UNIT II **CO2** **15 Periods**

Implementation of project: An overview of Project Planning and Scheduling - Management and Control of Projects - Network Analysis - PERT and CPM (Problems).

UNIT III **CO3** **15 Periods**

Entrepreneurship: An overview of Entrepreneurship - Characteristics and competencies of Entrepreneur - Entrepreneurial traits - Classification of Entrepreneurs - functions of Entrepreneur - Distinction between Entrepreneur, Intrapreneur and Manager - Entrepreneurial decision process

UNIT IV **CO4** **15 Periods**

Entrepreneurship growth and Development: Factors affecting Entrepreneurial Development – Economic and Non-Economic factors - Entrepreneurial Development Programs - Need and objectives of EDP – EDP programs in India - Entrepreneurial Motivation - theories of Maslow's and Mc Clelland's -MSME an introductory framework

Text Books:

1. Prasanna Chandra, Project Planning, Analysis, Selection, Implementation and Review, Tata McGraw Hill.
2. Rao. P.C.K., Project Management & Control, S. Chand, New Delhi.
3. Dr. S.S Khanka, Entrepreneurial Development, S. Chand and Company limited, New Delhi.
4. H. Nandan, Fundamentals of Entrepreneurship, PHI, New Delhi.

CO 412	**Professional Elective–III - Subjects**	
1.	COEL09	Neural Networks
2.	COEL10	Privacy and Security for IoT
3.	COEL11	Software Testing Tools
3.	COEL12	Augmented and Virtual Reality

CO 412

COEL09: Neural Networks

L P C
3 0 3

Course Objectives:

1. To introduce some of the fundamental techniques and principles of neural computation.
2. To investigate some common models and their applications.

Course Outcomes:

On completion of this course, a student should be able to:

1. Explain the features of single and multi-layer neural networks.
2. Discuss different learning mechanisms of Hopfield, Kohonen, SOM and LVQ networks.
3. Implement common learning algorithms Adaptive resonance theory.
4. Describe back propagation neural networks to classification and recognition problems.

Course Content:

UNIT I **CO1** **13 Periods**

Introduction, Simple Neural Networks for Pattern Classification: General Discussion, Hebb Net, Perceptron, Adaline.

UNIT II **CO2** **13 Periods**

Discrete Hopfield Net, Hamming Net, Kohonen Self-Organizing Maps, Learning Vector Quantization.

UNIT III **CO3** **10 Periods**

Adaptive Resonance Theory: Introduction, ART1, ART2.

UNIT IV **CO4** **14 Periods**

Standard Back Propagation Neural Net, Gaussian Machine, Cauchy Machine, Boltzmann with Machine Learning, Simple Recurrent Net.

Learning Resources:

Text Book:

1. Fundamentals of Neural Networks–Laurence Fausett, Pearson Education.2004.

Reference Books:

1. Introduction to Neural Networks Using Matlab6.0- S.N. Sivanandam, S.Sumathi,S.N.Deepa.
2. Neural Networks –James A.Freeman/ David A.Skapura, Pearson Education.
3. Neural Networks –Simon Haykin–2nd edition, Pearson Education.

CO 412

COEL10: Privacy and Security for IoT

L P C
3 0 3

Course Objectives:

1. To know the state-of-the-art methodologies in Cyber Physical system.
2. To impart knowledge on Model threats and counter measures.
3. To explore the Privacy Preservation and Trust Models in Internet of Things (IoT) To apply the concept of Internet of Things Security in the real-world scenarios

Course Outcomes:

1. Apply appropriate security mechanisms for IoT to real-world problems.
2. Reflect on the impact of current and future IoT technologies on security and privacy.
3. Discuss appropriate security and privacy solutions for real-world applications, using appropriate language and terminology.

Course Content:

Unit I **CO1** **13 Periods**

CYBER PHYSICAL SYSTEMS AND INTER CONNECTION OF THREATS:

IoT and cyber-physical systems, IoT security (vulner abilities, attacks, and counter measures), security engineering for IoT development, IoT security lifecycle. Network Robustness of Internet of Things-Sybil Attack Detection in Vehicular Networks-Malware Propagation and Control in Internet of Things-Solution-Based Analysis of Attack Vector son Smart Home Systems.

Unit II **CO2** **10 Periods**

CRYPTO FOUNDATIONS:

Privacy Preservation Data Dissemination- Privacy Preservation Data dissemination – Social Features for Location Privacy Enhancement in Internet of Vehicles-Light weight and Robust Schemes for Privacy Protection in Key Personal IoT Applications: Mobile WBSN and Participatory Sensing

Unit III **CO3** **11 Periods**

TRUST MODELS FOR IOT

Authentication in IoT- Computational Security for the IoT- Privacy-Preserving time Series Data Aggregation- Secure Path Generation Scheme for Real-Time Green Internet of Things- Security Protocols for IoT Access Networks- Framework for Privacy and Trust in IoT-Policy-Based Approach for Informed Consent in Internet of Things.

Unit IV **CO4** **12 Periods**

INTERNET OF THINGS SECURITY

Security and Impact of the Internet of Things (IoT) on Mobile Networks- Networking Function Security-IoT Networking Protocols, Secure IoT Lower Layers, Secure IoT Higher Layers, Secure Communication Links in IoTs, Back-end Security -Secure Resource Management, Secure IoT Databases, Security Products –Existing Test bed on Security and Privacy of IoTs, Commercialized Products.

Text Books:

1. Russell, Brian, and Drew VanDuren. Practical Internet of Things Security, 1st edition, Packet Publishing Ltd, 2016.
2. Hofei. Security and privacy in Internet of things (IoTs): Models, Algorithms, and Implementations,1st edition, CRC Press, 2016.

Reference Books:

1. White house O. Security of things: An implementers' guide to cyber-security for internet of things devices and beyond,1st edition, NCC Group, 2014
2. Da Costa, Francis, and Byron Henderson. Rethinking the Internet of Things: ascalable approach to connecting everything, 1st edition, Springer Nature, 2013

CO 412

COEL11: Software Testing Tools

L P C
3 0 3

Course Objectives:

At the end of the course, the student will understand

1. Software testing process effectively.
2. Design of high-quality tests during all phases of software development.
3. Criteria-based test design
4. Automation tools used in software development

Course Outcomes:

At the end of the course the students will be able to

1. Apply software testing knowledge and engineering methods.
2. Design and conduct a software test process for a software testing project.
3. Uses of t ware testing methods and modern software testing tools for their testing projects.
4. Identify and use various automation testing tools, and develops test cases for object oriented and web-based systems.

Course Content:

UNIT I **CO1** **15 Periods**

Software Testing: Introduction, Evolution, Myths & Facts, Goals, Psychology, Definition, Model for testing, Effective Vs. Exhaustive Software Testing.

Software Testing Terminology and Methodology: Software Testing Terminology, Software Testing Life Cycle, Software Testing Methodology.

Verification and Validation: Verification & Validation Activities, Verification, Verification of Requirements, High level and low-level designs, how to verify code, Validation.

UNIT II **CO2** **15 Periods**

Dynamic Testing, I: Black Box testing techniques: Boundary Value Analysis, Equivalence class Testing, State Table based testing, Decision table-based testing, Cause-Effect Graphing based testing, Error guessing

Dynamic Testing II: White-Box Testing: need, Logic coverage criteria, Basis path testing, Graph matrices, Loop testing, data flow testing, mutation testing

UNIT III **CO3** **15 Periods**

Static Testing: inspections, Structured Walk throughs, technical reviews

Validation activities: Unit testing, Integration Testing, Function testing, system testing, acceptance testing

Regression testing: Progressives Vs regressive testing, Regression testability, Objectives of regression testing, when regression testing done? Regression testing types, Regression testing techniques.

Debugging: an Artor Technique? Debugging Process, Debugging Is Difficult, Debugging Techniques, Correcting the Bugs, Debuggers.

UNIT IV **CO4** **15 Periods**

Automation and Testing Tools: need for automation, categorization of testing tools, selection of testing tools, Cost incurred, Guidelines for automated testing, overview of some commercial testing tools.

Testing Object Oriented Software: basics, Object oriented testing

Testing Web based Systems: Challenges in testing for web based software, quality aspects, web engineering, testing of web based systems.

Learning Resources:

Text Books:

1. Software Testing, Principles and Practices, Naresh Chauhan, Oxford University Press, 2011.

Reference books:

1. Software testing techniques-Baris Beizer, International Thomson computer press, second edition.
2. Software Testing, Principles, techniques and Tools, MG Limaye, TMH
3. Effective Methods for Software testing, WillianE Perry,3ed, Wiley
4. Foundations of Software testing, Aditya PM athur,2ed, Pearson
5. Software Testing-Yogesh Singh, CAMBRIDGE

CO 412

COEL12: Augmented and virtual Reality

L P C

3 0 3

Course Objectives:

The main objectives of this course are to:

1. Recognize the basic components of Virtual Reality technology.
2. Acquire Knowledge on Computing Architecture and Modeling concepts of Virtual Reality.
3. Distinguish the factors that influence the system performance in virtual reality.
4. Relate the Virtual Realty Applications in various domains.

Course Outcomes:

After successful completion of the course, students will be able to:

1. Distinguish the fundamental technologies and equipment used in virtual reality;
2. Investigate the theoretical contexts relevant to computing and modeling features in VR development.
3. Analyze the current generation systems for creating VR environments.
4. Identify the current VR technologies and next generation applications across all fields.

Course Content:

UNIT I **CO1** **12 Periods**

Introduction: The Three I's Virtual Reality, A short History of Early Virtual Reality, early commercial VR Technology, VR Becomes an Industry, The five classic Components of a VR system.

Input Devices: Trackers, Navigation and Gesture Interfaces: Three- Dimensional Position Trackers, Navigation and Manipulation Interfaces, Gesture Interfaces.

Output Devices: Graphics, Three-Dimensional Sound and Hap tic Displays: Graphics Displays Sound Displays, Hap tic Feedback.

UNIT II **CO2** **14 Periods**

Computing Architectures for VR: The Rendering Pipe line Rendering, PC Graphics Architecture Workstation-Based Architectures, Distributed VR Architectures.

Modelling: Geometric modelling, Kinematics Modelling, Physical Modelling, Behaviour Modelling, Model Management.

UNIT III **CO3** **12 Periods**

VR Programming: Toolkits and Scene Graphs, World Toolkit, JAVA3D, General Hap tics Open Software Toolkit, People shop.

Human Factors in VR: Methodology and Terminology, User Performance Studies, VR Health and Safety Issues, VR and Society.

UNIT IV **CO4** **12 Periods**

Traditional VR Applications: Medical Applications of VR, Education, Arts and Entertainment, Military VR Applications.

Emerging Applications of VR: VR Applications in Manufacturing, Applications of VR in Robotics, Information Visualization.

Learning Resources:

Text Book:

1. Grigore C. Burdea, Philippe Coiffet. "VirtualReality" Second Edition, Wiley India.

Reference Books:

1. Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002

2. Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig, William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009.

3. Oliver Bimber and Ramesh Raskar, "Spatial Augmented Reality: Meging Real and Virtual Worlds", 2005.

CO 413		Professional Elective–IV – Subjects
1.	COEL13	Optimization Techniques
2.	COEL14	Big Data Analytics
3.	COEL15	Block Chain Technologies
3.	COEL16	Deep Learning

CO 413

COEL13: Optimization Techniques

L P C
3 0 3

Course Objectives

1. Impart knowledge on theory of optimization and conditions for optimality for unconstraint and constraint optimization problems
2. Inculcate modeling skills necessary to describe and formulate optimization problems in design and manufacturing
3. Familiarize with the working principle of optimization algorithms used to solve linear and non-linear problems

Course Outcomes

- CO1: Formulate the engineering problems as an optimization problem.
- CO2: Apply necessary and sufficient conditions for a given optimization problem for optimality
- CO3: Select appropriate solution methods and strategies for solving an optimization problem and interpret and analyse the solution obtained by optimization algorithms
- CO4: Justify and apply the use of modern heuristic algorithms for solving optimization problems

Course Content:

UNIT I **CO1** **12 Periods**

Convex Optimization with Sparsity-Inducing Norms: Introduction, Generic Methods, Proximal Methods, Coordinate Descent Algorithms, Reweighted-l2 Algorithms, Working-Set Methods, Quantitative Evaluation, Extensions.

Interior-Point Methods for Large-Scale Cone Programming: Introduction, Primal-Dual Interior-Point Methods, Linear and Quadratic Programming, Second-Order Cone Programming, semi definite Programming.

UNIT II **CO2** **12 Periods**

Incremental Gradient, Sub gradient, and Proximal Methods for Convex Optimization: Introduction, Incremental Sub Gradient-Proximal Methods, Convergence for Methods with Cyclic Order, Convergence for methods with Randomized Order, Some Applications.

First-Order Methods for Non smooth Convex Large-Scale Optimization, I: Introduction, Mirror Descent Algorithm: Minimizing over a Simple Set, Problems with Functional Constraints, Minimizing Strongly Convex Functions, Mirror Descent Stochastic Approximation, Mirror Descent for Convex-Concave Saddle-Point Problems, Setting up a Mirror Descent Method.

UNIT III **CO3** **12 Periods**

First-Order Methods for Non smooth Convex Large-Scale Optimization, II: Introduction, Saddle-Point Reformulations of Convex Minimization Problems, Mirror-Prox Algorithm, Accelerating the Mirror-Prox Algorithm, Accelerating First-Order Methods by Randomization.

Cutting-Plane Methods in Machine Learning: Introduction to Cutting-plane Methods, Regularized Risk Minimization, Multiple Kernel Learning, MAP Inference in Graphical Models.

UNIT IV **CO4** **12 Periods**

Introduction to Dual Decomposition for Inference: Introduction, Motivating Applications, Dual Decomposition and Varangian Relaxation, Sub gradient Algorithms, Block Coordinate Descent Algorithms, Relations to Linear Programming Relaxations, Decoding: Finding the MAP Assignment.

Augmented Lagrangian Methods for Learning, Selecting, and Combining Features: Introduction, Background, Proximal Minimization Algorithm, Dual Augmented Lagrangian (DAL) Algorithm, Connections, and Application.

Learning Resources:

Text Books:

1. Optimization in Machine Learning, Suvrit Sra, Sebastian Nowozin, Stephen J. Wright, MIT Press, 2011.

CO 413

COEL14: Big Data Analytics

L P C
3 0 3

Course Objectives:

At the end of the course the students will understand

1. Big data analytics techniques.
2. Techniques required to manage and analyze big data problems.
3. Principles in achieving big data analytics with scalability and streaming capability.
4. Techniques to solve complex real-world analytics problems.

Course Outcomes:

At the end of this course a student will be able to

1. Demonstrate the key issues in big data management and its associated applications.
2. Apply fundamental enabling techniques and scalable algorithms in big data analytics.
3. Interpret models for similarity and distance measures.
4. Build data stream models and apply analytics principles.

Course Content:

UNIT I **CO1** **10 Periods**

Overview of Big Data: What is Big Data, Structuring Big Data, Elements of Big Data, Big Data Analytics.

Understanding Hadoop Eco-system: Hadoop Eco System, Hadoop Distributed File System, Hadoop YARN, Introducing H Base, Combining H Base and HDFS, Hive, Pig, Sqoop, Zoo Keeper, Flume.

No SQL Data Management: Introduction to No SQL, Types of No SQL data models, Key Value Data Model, Column Oriented Data Model, Document Data Model, Graph Databases, Schema-Less Databases, Materialized Views, Distribution Models, Sharding.

UNIT II **CO2** **15 Periods**

Data Mining: What is Data Mining? Statistical Limits on Data Mining. Things useful to know.

Map Reduce Software Stack: Distributed File Systems, Map Reduce, Algorithms Using Map Reduce, Extensions to Map Reduce, The Communication Cost Model.

Finding Similar Items: Applications of Near- Neighbor Search, Shingling of Documents, Similarity- Preserving Summaries of Sets, Locality-Sensitive Hashing for Documents, Distance Measures.

UNIT III **CO3** **15 Periods**

Mining Data Streams: The Stream Data Model, Sampling Data in a Stream, Filtering Streams. Mining, Counting Distinct Elements in a Stream.

Link Analysis: Page Rank, Efficient Computation of Page Rank, Topic- Sensitive Page Rank, Link Spam.

Social-Network Graphs: Social Networks as Graphs, Clustering of Social-Network Graphs, Direct Discovery of Communities, Partitioning of Graphs.

UNIT IV **CO4** **10 Periods**

Understanding Analytics and Big Data: Comparing Reporting and Analysis, Types of Analytics, Points to consider during Analysis, Developing an Analytic Team, Understanding Text Analytics.

Exploring R: Variables in R, Working with Vectors, Storing and Calculating values in R, Creating and using objects, Executing Scripts, Creating Plots.

Reading Data set and Exporting Data from R: c()command, scan() Command, Reading multiple data values from large files, exporting data from R, creating sub sets in data frames.

Learning Resources:

Text Books:

1. BIG DATA Black Book, Dream tech Press, 2015.
2. Jure Leskovec, Anand Raja raman, Jeffrey David Ullman, Mining of Massive Datasets, 2nd Edition, 2014.

Reference Books:

1. Taming the Big Data Tidal Wave: Finding Opportunities in huge data streams with advanced analytics, Bill Franks, Wiley Publishers,2010.
2. Understanding Big data: Analytics for enterprise class Hadoop and streaming data, Paul Zikopoulos, Chiris Eaton ,Mc Graw Hill Education.

CO 413

COEL15: Block Chain Technologies

L P C
3 0 3

Course Objectives:

To introduce Bit coin and other crypto currencies.

- ➢ To study the algorithms and techniques in block chain.
- ➢ To understand the practical aspects in the design of crypto currency.
- ➢ To understand the function of Block chains as a method of securing distributed ledgers.
- ➢ To design, code, deploy and execute a smart contract.

Course Outcomes:

On completion of the course, student will be able to

CO1 – Understand the structure of a block chain.

CO2 - Analyze the incentive structure in a block chain-based system.

CO3 - Judge the scenario where "smart" contract is most appropriate.

CO4 - Identify Basic knowledge of securing and inter connecting public and private Block chains

CO5 – understand the usage, interact and mining of crypto currencies

CO6 - Understand the various Block Chain applications.

Course Content:

UNIT 1 **CO1**

Introduction To Blockchain **10 Hrs.**

Basics of block chain-Public Ledgers-Block Chain as Public Ledgers-Types of Block chains- Pillars of Block chain Government Initiatives of Block Chain-Bitcoin-Smart Contracts

UNIT 2 **CO2&CO3**

Architecture and Conceptualization of Block Chain, Crypto Currencies **15 Hrs.**

Block in a Block chain-find Transactions-Distributed Consensus-Proof of work, Stake, Space-Attacks on POW-Ethereum POS/POW Hybrids-Crypto currency to block chain 2.0, Model of Blockchain-Algorand.

UNIT 3 **CO4**

Crypto Primitives, Securing and Interconnecting Public and Private Block Chains **10 Hrs.**

Hash Function and Merle Tree-Security Properties-Security Considerations for block chain-Digital Signature-Public Key Cryptography-Bit coin block chain incentive structures- Nash Equilibriums- evolutionary stable strategies, -and Pareto efficiency (game theory) Weaknesses and news Points of Failure, Mitigation Methods, Redundancies and fallbacks methods

UNIT 4 **CO5 & CO6**

Mining and Crypto Currencies - How to Use and Interact **15 Hrs.**

Mining-Pools-Impact of CPU and GPU-Transaction in Bit coin Network- Block Mining-Block propagation and block relay.

Use Cases-Applications in different areas

Industry applications of Block chain-Blockchain in Government-Government use cases-Preventing Cyber crime through block chain-Block Chain in defense, tax payments.

TEXT / REFERENCE BOOKS

1. Mastering Bitcoin: Unlocking Digital Crypto currencies, by Andreas Antonopoulos O'Reilly, 1st Edition, 2014.
2. Blockchain by Melanie Swa, O'Reilly Media 2015.
3. Zero to Block chain - An IBM Redbooks course, by Bob Dill, David Smits.

CO 413

COEL16: Deep Learning

L P C
3 0 3

Course Objectives:

The main objectives of this course are:

1. Introduce basic concepts and applications of neural networks and deep neural networks.
2. Discuss regularization and optimization techniques in neural networks.
3. Illustrate tools in convolutional neural networks.
4. Describe computational graphs to define recurrent neural networks
5. Demonstrate practical methodologies deep learning.

Course Outcomes:

After successful completion of the course, the students are able to:

1. Apply the regularization for deep learning
2. Implement optimization techniques for neural network training
3. Construct, train and use recurrent neural networks.
4. Use deep learning to solve practical problems

Course Content:

UNIT I **CO1** **15 Periods**

Deep Feed Forward Networks: Example: Learning XOR, Gradient-Based Learning, Hidden Units, Architecture, Back-Propagation and Other Differentiation Algorithms.

Regularization for Deep Learning: Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Data set Augmentation, Noise Robustness, Semi-Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging and Other Ensemble Methods, Dropout, Adversarial Training, Tangent Distance, Tangent Prop, and Manifold Tangent Classifier.

UNIT II **CO2** **15 Periods**

Optimization for Training Deep Models: How Learning Differs from Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates, Approximate Second-Order Methods, Optimization Strategies and Meta-Algorithms.

Convolutional Networks: The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features, The Neuro scientific Basis for Convolutional Networks, Convolutional Networks and the History of Deep Learning.

UNIT III **CO3** **15 Periods**

Sequence Modeling: Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, The Challenge of Long-Term Dependencies, Echo State Networks, Leaky Units and Other Strategies for Multiple Time Scales, The Long Short-Term Memory and Other Gated RNNs, Optimization for Long-Term Dependencies, Explicit Memory

UNIT IV **CO4** **14 Periods**

Practical Methodology: Performance, Default Baseline Models, Determining Whether to Gather More Data, Selecting Hyper parameters, Debugging Strategies,
Example: Multi-Digit Number Recognition.

Applications: Large-Scale Deep Learning, Computer Vision, Speech Recognition, Natural Language Processing, Other Applications

Text Book:

1. Good fellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.

Reference Books:

1. Charu Aggarwal, Neural Networks and Deep Learning A Textbook, Springer, 2018

CO 415	Job Oriented Elective III- Subjects	
S.NO	**Subject Code**	**Name of the Subject**
2.	JOEL10	IoT cloud and Data Analytics
3.	JOEL19	Embedded Systems

CO 415

JOEL10: IoT cloud and Data Analytics

L P C
3 0 3

Course Objectives:

Upon completing this course, students should be able to:

1. Explain what "Data Analytics" term means
2. Differentiate between traditional Data Analytics and Data Analytics for IoT
3. Enumerate and describe the fundamental concepts of Data Analysis for IoT

Course Outcomes:

1. Demonstrate the ability to translate IoT data in to action able business in sights
2. Evaluate the use of IoT data from acquisition through cleansing, warehousing, analytics, and visualization to drive business decisions
3. Apply Data Analytics to real-world IoT datasets

Course Contents:

UNIT I **CO1** **12 Periods**

Introduction to Data analytics and tools: Defining IoT analytics, defining the Internet of things, IoT analytics Challenges.

IoT Analytics for the Cloud: Building elastic analytics, elastic analytics concepts, designing for scale, cloud security and analytics, The AWS overview and Microsoft Azure overview.

UNIT II **CO2** **12 Periods**

IoT Data Collection Strategies and Techniques: Designing data processing for analytics, applying big data technology to storage, Apache spark for data processing and to stream or not to stream.

EDA for IoT Data: Exploring and visualizing data, installing R and RStudio and Using R for statistical analysis. Solving industry – specific analysis problems.

IoT Data set augmentation: adding internal and external datasets

UNIT III **CO3** **11 Periods**

IoT Data Visualization and Dash boarding: common Mistakes when designing visuals the hierarchy of questions method, designing visual analysis for IoT Data, Creating a dashboard with Tableau.

Applying Geospatial analytics to IoT Data: Basics of geospatial analysis, Vector based methods and Raster based Methods storing geospatial data. Processing geospatial Data.

UNIT IV **CO4** **10 Periods**

Data Science for IoT Analytics: Machine Learning, Anomaly detection using R Forecasting using ARIMA and Deep Learning

Strategies to Organize Data for Analytics: Linked Analytical Datasets, Managing Data lakes and The data retention strategy.

Text book:

1. Analytics for the Internet of Things (IoT): Intelligent analytics for your intelligent devices Paperback, Andrew Minteer.

CO 415

JOEL19: Embedded Systems

L P C
3 0 3

Course Objectives:

1. To understand the concept of an embedded system, to get the clarity of various design metrics for a system, understand the concept of improving productivity by presenting a unified view of software & hardware.
2. To understand general purpose processors and standard single purpose processors.
3. To understand memory types, hierarchy, cache systems, and standard processor peripherals for optimizing their integration across diverse computing applications. Top of Form Bottom of Form
4. To grasp the advanced techniques for programming embedded systems including state machine models & concurrent process models.

Course Outcomes:

1. After successful completion of the course, the students are able to
1. Outline the knowledge on Processor, IC and Design Technologies.
2. Demonstrate the customization of Hardware/software and Discover problems in optimization of custom single purpose processor.
3. Analyze hardware and software interactions involving memory and processor peripherals.
4. Distinguish Models, S.P.P and G.P.P, Priority Inversion and inheritance protocols, Embedded and real time and hand-held operating systems.

Course Contents:

UNIT I **CO1** **10 Periods**

Introduction to embedded systems: Overview of embedded systems, Embedded Systems Vs General Computing Systems, Major application areas, Characteristics of Embedded Systems, Classification of Embedded Systems, design challenge- optimizing design metrics
Embedded processor technology: IC technology, design technology, tradeoffs.

UNIT- II **CO2** **10 Periods**

Custom single-Purpose processors: Hardware Introduction, Combinational Logic, Sequential Logic, Custom Single-Purpose Processor Design, RT-Level Custom Single-Purpose Processor Design, Optimizing the Custom Single-purpose processors.
General purpose processors: Software, Introduction, Basic Architecture, Operation, programmer's View. Development Environment, Application-Specific Instruction-Set Processors (ASIPs) -Micro Controllers, Selecting a Microprocessor.

UNIT-III **CO3** **10 Periods**

Memory: Common Memory types, Composing Memory, Memory Hierarchy and Cache.
Standard Single-Purpose Processors: Peripherals, Introduction: Timers, Counters and Watchdog Timers, UART, Pulse Width Modulators, LCD Controllers, Keypad Controllers, Steeper Motor Controllers, Real-Time Clocks.

UNIT- IV **CO4** **10 Periods**

State machine and concurrent process models: Introduction, models vs languages, Basic State Machine Model, An Introductory Example, FSM, FSMD, using state machines, HCFSM and the state charts language, program state machine model (PSM), The role of an appropriate Model and Language concurrent process model, concurrent processes, communication and synchronization among processes, Implementation, data flow model and real time systems.

Learning Resources:

Text Books:

1. Frank Vahid, Tony D Givarg is - Embedded system design - A unified HW/ SW Introduction, John Wily & sons 2002.
2. KVKK Prasad - Embedded and real time systems, Dream tech Press, 2005.

Reference Books:

1. Raj Kamal, Embedded system architecture, programming and design, TMH edition.
2. Jonathan W Valvano, Embedded Microcomputer Systems, Brooks/cole, Thompson Learning.
3. David E. Simon, An Embedded Software Primer, Pearson edition

COSL5

NumPy and Pandas

L	P	C
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Course Objectives:

At the end of the course, the student will understand

1. The importance of NumPy and Pandas libraries in Python
2. To Handle Multi dimensionality data and its operations using Advance Numpy.
3. Understand the strategies of data collection and Pre-processing
4. Learn the Exploratory Data Analytics Using Pandas.

Course Outcomes:

At the end of the Course student will be able to

CO1. Install and Describe the importance of Numpy Library for solving Arrays and its operations. CO2. Develop Applications using Advanced Numpy to Handle Matrix class and Broad casting.

CO3. Install and Describe the importance of Pandas Library for Series, Data frames and data cleaning. CO4. Develop timeseries and other applications using Pandas.

Unit-1 CO1 12 periods

Numpy Basics:

Introduction to numpy, comparison between python lists and numpy arrays, creation of arrays, LINSPACE, zero, One-dimensional Arrays and Multi dimensional Arrays. Indexing and Slicing, Data Type Objects, DType and input and output of structured Arrays,

Numerical Operations on numpy arrays, Scalars, Matrix Multiplication, comparison operators, logical operators, Distance Matrix.

Unit-II CO2 12 periods

Numpy Arrays : Concatenating Flattening and adding Dimensions , Flatten and Reshape arrays, Concatenating Arrays, Adding New dimensions, Vector Stacking, TILE Method Repeating Patterns

Data Processing Using Arrays: Expressing Conditional Logic as Array Operations, Statistical Methods, Methods for Boolean Arrays, Sorting and File INPUT And OUTPUT With Arrays.

Advanced Numpy : Broadcasting, Structure and record arrays , Numpy Matrix Class and AdvancesArray Input and Output.

UNIT-III CO3 12 periods

Getting Started with Pandas:

Introduction to Pandas Data Structures: Series, Data Frame and Index Objects.

Essential Functionality: Reindexing, dropping entries, selection and filtering, Sorting and RankingSummarizing and Computing Descriptive Statistics, Handling Missing Data, Hierarchical Indexing.

Data Loading, Storage and File Formats, Data Wrangling: Clean, Transform , Merge, Reshape

Unit-IV CO4 12 periods

Data Aggregation and Group Operations: Group by Mechanics, Data Aggregation, Group-wiseoperations and transformations, Pivot tables and Cross Tabulation

Time Series : Data and Time Data types and Tools , Time Series Basics, Date ranges, Frequencies andshifting, Time Zone Handling, Period Arithmetic, Time Series Plotting

Finanicial and Economic Data Applications : Data Munging Topics , Group Transforms and Analysis

Text Books:

1. Python for Data Analysis Orielly Publications Wes McKinney
2. Data Analysis Numpy, Matplotlib and Pandas Bernd Klein

Reference Books:

1. Time Series Analysis with Python Cookbook: Practical recipes for exploratory dataanalysis, data preparation, forecasting, and model evaluation
2. Python Data Analytics: With Pandas, NumPy, and Matplotlib by Fabio Nelli (Author)
3. Robert Johansson, Numerical Python – Scientific Computing and Data Science Applicationswith NumPy, SciPy and Matplotlib, Apress, 2019